**ORGANIZING THEME/TOPIC**

### Robotics now and in our future

- How does robotic technology affect our lives?
- How might I work with robots in my future?

**Robotics and Engineering**

ITEEA 1.6-8F New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

ITEEA 4.6-8D The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use.

- Identify positive and negative impacts of technology on society and the environment. (4.6-8E)
- Demonstrate understanding of the relationships among technologies and the connections between technologies and other fields of study. (3.6D)
- Identify examples of links between creativity and technology, which has resulted in innovation and changes in how we use technology. (1.6-8E,H)

**Career and College Readiness**

- Technical Reading: Use information provided in manuals, protocols, or by experienced people to see and understand how things work.
- Explore robotics in various careers and secondary and college opportunities related to these careers.

**Time Frame:** 1 week and integrated into selected units

### Engineering Design Process

- How does the engineering design process lead to better solutions?

**Robotics and Engineering:**

ITEEA.9.6-8F Design involves a set of steps, which can be performed in different sequences and repeated as needed.

- Collaborate in brainstorming solutions to meet a need or challenge.
- Construct 2 and/or 3-dimensional representations of a designed solution.
- Test a design against pre-established criteria and refine as needed.
- Record and analyze experimental data to identify best solution.
- Troubleshoot to identify the cause of a malfunction in a technological system.
- Utilize virtual simulation to test a solution design.

**Career and College Readiness**

- Technical writing: Document design process by creating design portfolios, journals, drawings, sketches, or schematics. (ITEEA 11.L)
- Mathematical practices: Utilize computers and calculators in the design process of products and systems. (ITEEA 12J)
- Mathematical practices: Make sense of problems and persevere in solving them. (KCCRS.MC 8 SP.A.1)

**Time Frame:** integrated in increasingly complex projects, and 4-5 weeks for culminating design challenge

---

**FOCUS STANDARDS & SKILLS**

<table>
<thead>
<tr>
<th>ORGANIZING THEME/TOPIC</th>
<th>FOCUS STANDARDS &amp; SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Robotics now and in our future</strong></td>
<td><strong>Robotics and Engineering</strong></td>
</tr>
<tr>
<td>How does robotic technology affect our lives?</td>
<td>ITEEA 1.6-8F New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.</td>
</tr>
<tr>
<td>How might I work with robots in my future?</td>
<td>ITEEA 4.6-8D The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology’s development and use.</td>
</tr>
<tr>
<td>Automation</td>
<td>Identify positive and negative impacts of technology on society and the environment. (4.6-8E)</td>
</tr>
<tr>
<td>Robotics</td>
<td>Demonstrate understanding of the relationships among technologies and the connections between technologies and other fields of study. (3.6D)</td>
</tr>
<tr>
<td>Human interaction with robots</td>
<td>Identify examples of links between creativity and technology, which has resulted in innovation and changes in how we use technology. (1.6-8E,H)</td>
</tr>
<tr>
<td>Influence on our lives and our society</td>
<td><strong>Career and College Readiness</strong></td>
</tr>
<tr>
<td>Careers and opportunities related to robotics</td>
<td>Technical Reading: Use information provided in manuals, protocols, or by experienced people to see and understand how things work.</td>
</tr>
<tr>
<td></td>
<td>Explore robotics in various careers and secondary and college opportunities related to these careers.</td>
</tr>
<tr>
<td><strong>Time Frame:</strong> 1 week and integrated into selected units</td>
<td><strong>Robotics and Engineering:</strong></td>
</tr>
<tr>
<td><strong>Engineering Design Process</strong></td>
<td>ITEEA.9.6-8F Design involves a set of steps, which can be performed in different sequences and repeated as needed.</td>
</tr>
<tr>
<td>How does the engineering design process lead to better solutions?</td>
<td>- Collaborate in brainstorming solutions to meet a need or challenge.</td>
</tr>
<tr>
<td></td>
<td>- Construct 2 and/or 3-dimensional representations of a designed solution.</td>
</tr>
<tr>
<td></td>
<td>- Test a design against pre-established criteria and refine as needed.</td>
</tr>
<tr>
<td></td>
<td>- Record and analyze experimental data to identify best solution.</td>
</tr>
<tr>
<td></td>
<td>- Troubleshoot to identify the cause of a malfunction in a technological system.</td>
</tr>
<tr>
<td></td>
<td>- Utilize virtual simulation to test a solution design.</td>
</tr>
<tr>
<td><strong>Engineering Design Process</strong></td>
<td><strong>Career and College Readiness</strong></td>
</tr>
<tr>
<td>- Research and investigation</td>
<td>Technical writing: Document design process by creating design portfolios, journals, drawings, sketches, or schematics. (ITEEA 11.L)</td>
</tr>
<tr>
<td>- Solution finding (criteria and constraints)</td>
<td>Mathematical practices: Utilize computers and calculators in the design process of products and systems. (ITEEA 12J)</td>
</tr>
<tr>
<td>- Sketching and Drafting a solution</td>
<td>Mathematical practices: Make sense of problems and persevere in solving them. (KCCRS.MC 8 SP.A.1)</td>
</tr>
<tr>
<td>- Prototype development</td>
<td></td>
</tr>
<tr>
<td>- Testing (controlling variables)</td>
<td></td>
</tr>
<tr>
<td>- Data collection and analysis</td>
<td></td>
</tr>
<tr>
<td>- Redesign</td>
<td></td>
</tr>
<tr>
<td>- Presentation of solution</td>
<td></td>
</tr>
<tr>
<td><strong>Engineering Design Journal or Design Brief</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Time Frame:</strong> integrated in increasingly complex projects, and 4-5 weeks for culminating design challenge</td>
<td></td>
</tr>
</tbody>
</table>
### Robotics – How mechanisms work

**How do robots work?**

**How do the mechanics of a robot affect its capabilities?**

- Simple and complex machines
- Assembly
- Potential and kinetic energy
- Mechanisms
  - Motors,
  - Gears and gear ratios
  - Drivetrain
  - Object manipulation
- Electrical circuitry
- Remote control

**Time Frame:** 3 weeks and integrated throughout projects

### Coding for Robotics

**How can I program a robot to function autonomously?**

- Systems and subsystems
- Open and closed loop systems
- Programming in Robot C (graphical and text)
  - Commands
  - Functions
  - Algorithms
  - Variables
  - Conditional code (if/else)
  - Loops
- Problem-solving in the Design Process
  - Testing and Refining
  - Troubleshooting
  - Invention and Innovation

**Time Frame:** 10 weeks

### Robotics and Engineering:

**ITEEA.11.6-8H** Apply design process to solve a problem in and beyond the laboratory.
- Develop and follow a plan of procedure for making or assembling a product.
- Build mechanisms to accomplish a task using knowledge of simple machines
- Select and design a power system to move an object and do work.
- Create circuitry to support
  - Motors
  - Remote control
  - Lights and sounds
- Predict and test outcome of altering gear ratios.

### Career and College Readiness

- Technical Reading: Interpret information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. (KCCRS RI.6.7)

### Robotics and Engineering:

**ITEEA.02** Demonstrate an understanding of the core concepts of technological systems (including input, process, out, and feedback).

**CSTA 2-C-4-12** Analyze the relationship between a device’s computational components and its capabilities

**CSTA 2-A-5-6** Develop programs, independently and collaboratively, that include sequences with nested loops and multiple branches

Apply programming concepts, sequencing and logic to create code (graphical and text) for autonomous robots
- Basic movement for distance (forward, backward)
- Controlled turns (by rotations, angles)
- Response to sensors (light, color, touch)

Decompose a problem into parts and create solutions for each part. (CSTA 2-A-3-9)
- Predict outcomes
- Test and refine
- Troubleshoot
- Receive peer feedback to detect bugs and improve outcomes

### Career and College Readiness

- Technical Reading: Interpret information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. (KCCRS RI.6.7)
- Mathematical practices: Utilize computers and calculators in the design process of products and systems. (ITEEA 12.J)
<table>
<thead>
<tr>
<th>Safety in the classroom lab</th>
<th>Robotics and Engineering:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why is safety important in the classroom lab?</td>
<td>ITEEA 12.6-8I  Use tools, materials, and machines safely.</td>
</tr>
<tr>
<td>Shop safety and organization</td>
<td>• Safely use hand and power tools and machines (band saw, drill press) to construct a project.</td>
</tr>
<tr>
<td>• Hand Tools</td>
<td>• Organize and use materials responsibly to construct a project.</td>
</tr>
<tr>
<td>• Power Tools</td>
<td>• Follow safety rules and procedures for the lab area.</td>
</tr>
<tr>
<td>• Equipment/machines</td>
<td></td>
</tr>
<tr>
<td>• Materials</td>
<td></td>
</tr>
<tr>
<td>Safety rules and procedures</td>
<td></td>
</tr>
</tbody>
</table>

**Measurement and Mathematics**

How is measurement and mathematics applied in robotics and engineering?

- Standard and Metric measurement
- Calculations
- Logic
- Gear ratios
- Efficiency

**Robotics and Engineering**

- Accurately use a standard and metric weights and measures as they are typically used in engineering fields. (KCCRS MP.6)
- Calculate measurements using fractions, whole numbers and decimals.

**Career and College Readiness**

- Apply knowledge and skills from other fields of study to the development of technological products or systems. (ITEEA 03.F)
- Attend to precision. (KCCRS.MP.6)

**Visual Communications**

How do I read mechanical drawings? How do I communicate my design ideas in a visual form?

- Application of Drafting and Design principles
  - Sketching
  - Mechanical drawings
  - Computer Aided Drafting (CAD)

**Robotics and Engineering**

- ITEEA 11.J  Make 2D and 3-D representation of designed solutions.
- Develop a pictorial sketch of an object.
- Develop a multi-view drawing (manual &/or CAD).

**Career and College Readiness**

- Technical Reading: Use information provided in manuals, protocols, or by experienced people to see and understand how things work (ITEEA 07.F)
- Technical Reading: Follow instructions to operate a product or system (ITEEA 09.F)
- Technical Writing: Demonstrate written or verbal communication utilizing measurements, drawing, or symbols. (ITEEA 17.K)

**Standards Alignment**

ITEEA - International Technology and Engineering Educators Association
CSTA - Computer Science Teachers’ Association
KCCRS – Kansas College and Career Ready Standards

**Primary Resources**

- Vex IQ online curriculum and lessons
- Carnegie Mellon online tutorials and challenges for programming Vex IQ
- Robot Virtual Worlds simulations